

Forecast for exchange-rates by both daily and monthly data

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1. Introduction

As for the rate of growth in real GDP of the Japanese economy, we have been able to represent 4.05% from 1980 to 1991, however, during the next period from 1992 to 1999, to indicate only 0.81% (the value of the government goal = 0.5% in 1999), in other words, a very abrupt slowdown of growth rate in real GDP, on average, one fourth, or one fifth rate of growth in 1990s compared with the last 12 years from 1980 to 1991⁽¹⁾.

In order to make a correct diagnosis of the main factors which have caused rather rapid slowdown of the rate of growth in real GDP, many economists, both Japanese and foreign, have tried to explain various causes of such a sudden loss of economic vitalities originated by long term structural changes of our economy in 1990s⁽²⁾, however, we should like to merely emphasize exceptionally the extremely large importance of the stability in the yen-dollar exchange-rate.

In order that we may show the too large-scale fluctuations of the yen-dollar rate, it would enough to represent the very abrupt changes of the exchange-rates in the following ways: yen-dollar rate has been 134.5 yen per dollar in 1991, 126.7 yen in 1992, 111.2 yen in 1993, 102.2 yen in 1994 and, at last, 79.75 yen in April 1995, then, has depreciates to 147 yen in June 1998 and has appreciated again to 103 yen in September 1999⁽³⁾.

This is the reason why we intend to accentuate the instability of yen-dollar exchange-rate as the most serious economic and political problem to our economy in 1990s and at the beginning of 21st century. Of course, there exist very complicated economic relationships between the abrupt large-scale variations of yen-dollar rates and their impacts on the Japanese economy, but we are going to

explain and forecast directly for the future movements of the exchange-rate without analysis of the influences of exchange-rate on our economy.

First of all, we would examine very briefly two articles on the analysis of the exchange-rates utilizing daily data, the one by three French economists and the other by an American economist.

French economist, Frédérique Bec, Mélilea Ben Salem and Emma Ben Youssef⁽⁴⁾, have developed an empirical analysis of the exchange market efficiency hypothesis by using daily data for the main nominal exchange rates vis-à-vis the US dollar over the period spanning from January 1990 to March 1994. At the beginning of the analysis, they have provided the various results of the tests of unit root⁽⁵⁾ and in the second section of their article, the interpretation of the jointed dynamics on the four main nominal exchange rates has been shown in order to verify the compatibility with the hypothesis of the exchange market efficiency. According to the theorem of the representation of Granger⁽⁶⁾, if two variables, x_t and y_t , are $I(1)$ and cointegrated, then, the following vectorial representation in errors correction (VECM) exist:

$$\begin{aligned}\Delta x_t &= c_1 - \rho_1 Z_{t-1} + \sum_{k=1}^p a_k^1 \Delta x_{t-k} + \sum_{k=1}^p b_k^1 \Delta y_{t-k} + \varepsilon_{1t} \\ \Delta y_t &= c_2 - \rho_2 Z_{t-1} + \sum_{k=1}^p a_k^2 \Delta x_{t-k} + \sum_{k=1}^p b_k^2 \Delta y_{t-k} + \varepsilon_{2t}\end{aligned}$$

where $Z_t = x_t - Ay_t$, les ε_{it} are the white noises, eventually correlated, and $|\rho_1| + |\rho_2| \neq 0$.

They have also represented the results of the tests of cointegration and of the tests on the short-term dynamics by using the method of generalized moments⁽⁷⁾.

On the other hand, an American economist, D. J. Hodgson, has equally shown the results of an empirical application on the forward exchange market unbiasedness model using a sample of 650 daily observations on the Canada-US spot and 90-day forward exchange rates using an error correction representation and a maintained hypothesis of zero intercept⁽⁸⁾.

According to his analysis, the model and notation are expressed in a following way: the observable data consist of the univariate series $\{Y_t\}_{t=1}^n$ and the m -vector series $\{X_t\}_{t=1}^n$. He assumes that all $m+1$ series are $I(1)$ and that a single cointegrating relationship exists among them. He further assumes that derivations of the variable from their cointegrating relationship follow a stationary and invertible ARMA(r, q) process, Formally, he has:

$$Y_t = B_1 + X_t' B + u_t, \quad (1)$$

$$U_t = \sum_{j=1}^r a_j u_{t-j} + \sum_{j=1}^q b_j \varepsilon_{t-j} + \varepsilon_t, \quad (2)$$

$$X_t = X_{t-1} + v_t \quad (3)$$

Furthermore, he assumes that:

1. r and q are known;
2. the polynomials $1 - \sum_{j=1}^r a_j Z^j$ and $1 - \sum_{j=1}^q b_j Z^j$ have zeros strictly outside the unit circle and no zeros in common;
3. the full parameter vector is $\theta = (\eta', B_1, B')'$, where $\eta = (a_1, \dots, a_r; b_1, \dots, b_q)'$, and θ belongs to the parameter space Θ , which is defined by allowing $(B_1, B')'$ to take any value in R^{m+1} and η to take any value in R^{r+q} , subject to the restrictions mentioned in Assumption 2 above.
4. the innovation $(\varepsilon_t, v_t)'$ are *iid* from unknown elliptically symmetric Lebesgue density $p(\varepsilon, v)$, which has the property that

$$0 < \lambda^2 = \iint |\psi(\varepsilon, v)|^2 p(\varepsilon, v) dv d\varepsilon < \infty$$

where $\psi(\varepsilon, v) = (\partial p(\varepsilon, v) / \partial \varepsilon) / p(\varepsilon, v)$;

5. denoting the marginal Lebesgue density of v by $e(v)$, the conditional density of ε given v , $p(\varepsilon, v) / e(v)$, is absolutely continuous with respect to Lebesgue measure in ε , and the derivative $(\partial p(\varepsilon, v) / \partial \varepsilon) / e(v)$ exists almost everywhere; and
6. the initial conditions are $(\varepsilon_{1-q}, \dots, \varepsilon_0; Y_{1-r}, \dots, Y_0; X_{1-r}, \dots, X_0)$, assumed to be drawn from the distribution $f_0(\varepsilon_{1-q}, \dots, \varepsilon_0; Y_{1-r}, \dots, Y_0; X_{1-r}, \dots, X_0; \theta_n)$, which has the property that

$$\begin{aligned} & f_0(\varepsilon_{1-q}, \dots, \varepsilon_0; Y_{1-r}, \dots, Y_0; X_{1-r}, \dots, X_0; \theta_n) \\ & - f_0(\varepsilon_{1-q}, \dots, \varepsilon_0; Y_{1-r}, \dots, Y_0; X_{t-r}, \dots, X_0; \theta_n) = 0_p \end{aligned} \quad (1)$$

in P_{θ_0} , n as $\theta_n \rightarrow \theta_0$, where $\theta_n \in \Theta$ for each n and P_{θ_0} is the probability measure characterizing the distribution of the sample of size n at the parameter value $\theta^{(9)}$

He uses the parameters of the MA component of the model to define the infinite sequence of constants, $\{\gamma_k(\theta)\}$, as follows:

$$(1 + b_1 z + \dots + b_q z^q)^{-1} = \sum_{k=0}^{\infty} \gamma_k(\theta) z^k, \quad (4)$$

with the following formula holding:

$$\gamma_s(\theta) + b_1 \gamma_{s-1}(\theta) + \dots + b_q \gamma_{s-q}(\theta) = 0 \quad \forall_s \geq 1,$$

with $\gamma_s(\theta) = 0 \quad \forall_s \leq 0$ and $\gamma_0(\theta) = 1$. Note that $\gamma_k(\theta) \rightarrow 0$ as $k \rightarrow \infty$

Writing his model as

$$Y_t = g_t(Y_{t-1}, \theta_0) + \varepsilon_t,$$

where

$$g_t(Y_{t-1}, \theta_0) = B_{10} + X_t' B_0 + \sum_{i=1}^r a_{i0} u_{t-i} - \sum_{i=1}^{t-1} \gamma_i(\theta_0) \left[u_{t-i} - \sum_{j=1}^r a_{j0} u_{t-i-j} \right] \\ + \sum_{s=0}^{q-1} \varepsilon_{-s} \left(\sum_{k=0}^s \gamma_{t+s-k}(\theta_0) a_{k0} \right),$$

he can see that the conditional density of Y_t given A_{t-1} is just the conditional density of ε_t given v_t .

He now introduce the following stationary $(r+q)$ – vector:

$$Z_{t-1}(\eta_n, \eta_0, B_{10}, B_0) = \sum_{k=0}^{t-1} \gamma_k(\eta_n, B_{10}, B_0) \\ \times (u_{t-1-k}, \dots, u_{t-r-k}; \varepsilon_{t-1-k}, \dots, \varepsilon_{t-q-k})'$$

He obtains $\gamma_k(\eta_n, B_{10}, B_0)$ from (4) by replacing b_1, \dots, b_q with b_1^n, \dots, b_q^n where b_j^n is the relevant element of η_n .

Continuing his development of the notation, he defines

$$\bar{\gamma}_{t,n} = \left(\sum_{j=0}^{t-1} \gamma_j(\eta_n, B_{10}, B_0) \right) \left(1 - \sum_{k=1}^n a_k^n \right)$$

and

$$\Gamma_{t-1}^*(\eta_n, B_{10}, B_0) = \sum_{j=0}^{t-1} \gamma_j(\eta_n, B_{10}, B_0) \left(X_{t-j} - \sum_{k=1}^r a_k^n X_{t-j-k} \right),$$

and where a_k^n denotes the relevant element of the vector η_n . He further defines $\Gamma_{t-1}(\eta_n, B_{10}, B_0) = \Gamma_{t-1}^*(\eta_n, B_{10}, B_0) - v_t$. Note that $\Gamma_{t-1}(\eta_n, B_{10}, B_0)$ and $\Gamma_{t-1}^*(\eta_n, B_{10}, B_0)$ are both m -vectors integrated of order one.

Finally, he introduces the important quantity

$$d_t(\theta_n, \theta_0) = (\theta_n - \theta_0)' H_{t-1}^* = H_n' \delta_n H_{t-1}^*, \quad (5)$$

where $H_{t-1}^* = (Z_{t-1}', \bar{\gamma}_{t,n}, \Gamma_{t-1}^*)'$. In (5), he has simplified notation by writing $Z_{t-1}(\eta_n, \eta_0, B_{10}, B_0) = Z_{t-1}$, with Γ_{t-1}^* and H_{t-1}^* defined analogously. He also defines $\Gamma_{t-1} = \Gamma_{t-1}(\eta_n, \eta_0, B_{10}, B_0)$, $H_{t-1} = (Z_{t-1}', \bar{\gamma}_{t,n}, \Gamma_{t-1}')'$, and

$$H_{t-1}(\theta_0) = (Z_{t-1}(\eta_0, \eta_0, B_{10}, B_0)', \bar{\gamma}_t, \Gamma_{t-1}(\eta_0, \eta_0, B_{10}, B_0)')',$$

where $\bar{\gamma}_t = \left(\sum_{j=0}^{t-1} \gamma_j(\eta_0, B_{10}, B_0) \right) \left(1 - \sum_{k=1}^r a_{k0} \right)$. Note that

$$H_{t-1} = H_{t-1}^* - \begin{bmatrix} 0 \\ v_t \end{bmatrix},$$

so that (5) becomes

$$d_t(\theta_n, \theta_0) = K_n \delta_n H_{t-1} + K_n \delta_n \begin{bmatrix} 0 \\ v_t \end{bmatrix}. \quad (6)$$

These are the main part of his model and notation⁽¹⁰⁾ and he has evaluated the finite sample behaviour of the estimator through a small Monte Carlo experiment, and has represented the results of an empirical application to the foreign exchange market by utilizing daily data⁽¹¹⁾.

Both analyses, French and American, are concerned with directly with exchange market and lead to the statistically significant results by the test of unit root, the test of cointegration, arch model, ARMA model, adaptive estimation etc. However, in spite of these significant parameters obtained by sophisticated techniques using daily data, the assumption of random walk regressors, the assumption of elliptically symmetrically distributed innovations and etc. would not be able to clarify, or to interpret fully the very large-scale fluctuations of yen-dollar exchange-rate in 1990s which have been one of the most serious economic and political problems to our present economy that would be perhaps unable to explain completely on the standpoint of statistically much complicated methods and that would seem to need to be resolved by the another way to clarify the limits and restrictions of the explanations on the yen-dollar exchange market by contemporary econometric approaches.

Note

- (1) Economic planning agency, Keizai Yoran, the Ministry of Finance Press, 1998, Annual Report on National Accounts (with CD-ROM), Ministry of Finance Press, 1999.
- (2) Ryutaro Komiya, Masataka Sase & Masaru Eto "The Japanese Economy Forwards the 21st Century", Oriental Economist Publishing, 1997.
- (3) The Oriental Economist Publishing, "The exchange-rates & the rates of interest," CD-ROM for Windows 95, 1998. Nikkei telecom. 21, daily data, internet, 1999. 9. 24.
- (4) Bec, F., Saiem, M. B. & Youssef, E. B., (1997) "Une évaluation empirique de l'efficience du marché des changes," *Revue Economique*, numéro 4, juillet, PP., 921-936
- (5) *ibid.*, PP., 925-929
- (6) *ibid.*, PP., 929-933
- (7) *ibid.*, PP., 929-936

- (8) Hodgson, D. J., (1998), "Adaptive estimation of cointegrating regressions with ARMA errors, "Journal of Econometrics, 85, PP., 231-267
- (9) *ibid.*, PP., 231-234
- (10) *ibid.*, PP., 235-237
- (11) *ibid.*, PP., 237-253

2. After having taken in consideration both French and an American analyses on the exchange-rates by daily data in great detail, we have decided to make comparisons of the estimation and forecasting results by Box-Jenkins procedures between by monthly⁽¹⁾ data and by daily data⁽²⁾.

According to the next computations⁽³⁾ of test of unit root and of autocorrelation functions⁽⁴⁾ of daily data on the spot yen-dollar rates in Tokyo market ($x = \log(y/\$)$), we have judged the first order difference of log of yen-dollar rates, sometimes, with two period moving average, as a almost completely valid daily data for Box-Jenkins procedures⁽⁵⁾. Therefore, we are going to show the calculated results of test of unit root, autocorrelation Functions and their graphs and some parts of forecasts⁽⁶⁾. At the end of section 2, we have represented the Table 1, which indicates fairly good ameliorations of forecast for almost every period with 95% confidence bounds by daily data⁽⁷⁾ in comparison with by monthly data⁽⁸⁾.

Test of unit root⁽⁹⁾

Variable	Estimated Coefficient	Standard Error	t-statistic	P-value
X(-1)	.384222E-04	.221397E-04	1.73545	[.083]
DICKY-FULLER(NC, 4342, 0) Test Statistic: 1.735445, Lower tail area: .99616				

Variable	Estimated Coefficient	Standard Error	t-statistic	P-value
C	-.459612E-02	.348698E-02	-1.31808	[.188]
T	.106969E-06	.148551E-06	.720086	[.472]
X(-1)	.919256E-03	.651064E-03	1.41193	[.158]
DICKY-FULLER(CT, 4342, 0) Test Statistic: 1.411929, Lower tail area: .99994				

Current sample: 3 to 4344

Variable	Estimated Coefficient	Standard Error	t-statistic	P-value
D1X(-1)	-.994906	.015177	-65.5526	[.000]
DICKY-FULLER(NC, 4342, 0) Test Statistic: -65.55260, Lower tail area: .00000				

Variable	Estimated Coefficient	Standard Error	t-statistic	P-value
C	-.316133E-03	.219449E-03	-1.44058	[.150]
T	.622774E-07	.875089E-07	.711669	[.477]
D1X	-.995648	.015181	-65.5864	[.000]
DICKY-FULLER(CT, 4342, 0) Test Statistic: -65.58642, Lower tail area: .00000				

Autocorrelations

Series: X

Mean = 4.9446458

Std. Error = 0.28602768

	Lags					
Autocorrelations		0.999	0.998	0.998	0.997	0.996
Standard Errors	1-5	0.152E-01	0.263E-01	0.339E-01	0.401E-01	0.454E-01
Q-statistics		0.434E+04	0.867E+04	0.130E+05	0.173E+05	0.216E+05
Autocorrelations		0.995	0.995	0.994	0.993	0.992
Standard Errors	6-10	0.502E-01	0.546E-01	0.586E-01	0.624E-01	0.659E-01
Q-statistics		0.260E+05	0.303E+05	0.346E+05	0.389E+05	0.431E+05
Autocorrelations		0.991	0.991	0.990	0.989	0.988
Standard Errors	11-15	0.692E-01	0.724E-01	0.755E-01	0.784E-01	0.812E-01
Q-statistics		0.474E+05	0.517E+05	0.560E+05	0.602E+05	0.645E+05
Autocorrelations		0.987	0.986	0.986	0.985	0.984
Standard Errors	16-20	0.840E-01	0.866E-01	0.891E-01	0.916E-01	0.940E-01
Q-statistics		0.688E+05	0.730E+05	0.772E+05	0.815E+05	0.857E+05

Series: (1-B) X

Mean = -0.18383879E-03

Std. Error = 0.72266171E-02

	Lags					
Autocorrelations		0.462E-02	0.584E-02	-0.760E-02	-0.197E-02	-0.491E-02
Standard Errors	1-5	0.152E-01	0.152E-01	0.152E-01	0.152E-01	0.152E-01
Q-statistics		0.929E-01	0.241	0.492	0.509	0.614
Autocorrelations		0.911E-02	0.891E-02	-0.805E-03	0.187E-01	0.540E-01
Standard Errors	6-10	0.152E-01	0.152E-01	0.152E-01	0.152E-01	0.152E-01
Q-statistics		0.975	1.32	1.32	2.84	15.6
Autocorrelations		-0.187E-01	-0.129E-01	0.217E-01	0.102E-01	0.360E-01
Standard Errors	11-15	0.152E-01	0.152E-01	0.152E-01	0.152E-01	0.152E-01
Q-statistics		17.1	17.8	19.9	20.3	26.0
Autocorrelations		-0.166E-01	-0.237E-01	0.740E-02	0.163E-01	-0.133E-01
Standard Errors	16-20	0.153E-01	0.153E-01	0.153E-01	0.153E-01	0.153E-01
Q-statistics		27.2	29.6	29.9	31.0	31.8

Series: (1-B²⁰)X

Mean = 0.35275815E-02

Std. Error = 0.33765218E-01

	Lags					
Autocorrelations		0.953	0.908	0.863	0.818	0.773
Standard Errors	1-5	0.152E-01	0.255E-01	0.321E-01	0.371E-01	0.411E-01
Q-statistics		0.393E+04	0.750E+04	0.107E+05	0.136E+05	0.162E+05
Autocorrelations		0.730	0.686	0.644	0.602	0.558
Standard Errors	6-10	0.443E-01	0.470E-01	0.493E-01	0.512E-01	0.528E-01
Q-statistics		0.185E+05	0.206E+05	0.224E+05	0.239E+05	0.253E+05
Autocorrelations		0.511	0.467	0.424	0.380	0.335
Standard Errors	11-15	0.541E-01	0.552E-01	0.561E-01	0.569E-01	0.575E-01
Q-statistics		0.264E+05	0.274E+05	0.281E+05	0.288E+05	0.292E+05
Autocorrelations		0.287	0.239	0.193	0.148	0.102
Standard Errors	16-20	0.579E-01	0.582E-01	0.585E-01	0.586E-01	0.587E-01
Q-statistics		0.296E+05	0.299E+05	0.300E+05	0.301E+05	0.302E+05

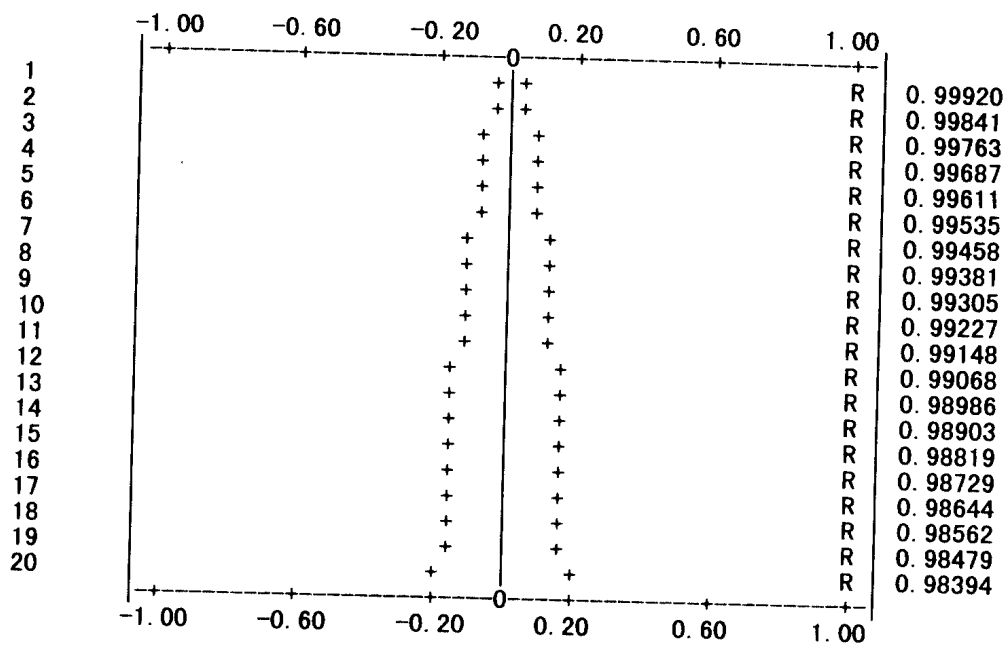
Series: (1-B)(1-B²⁰)X

Mean = -0.21751297E-04

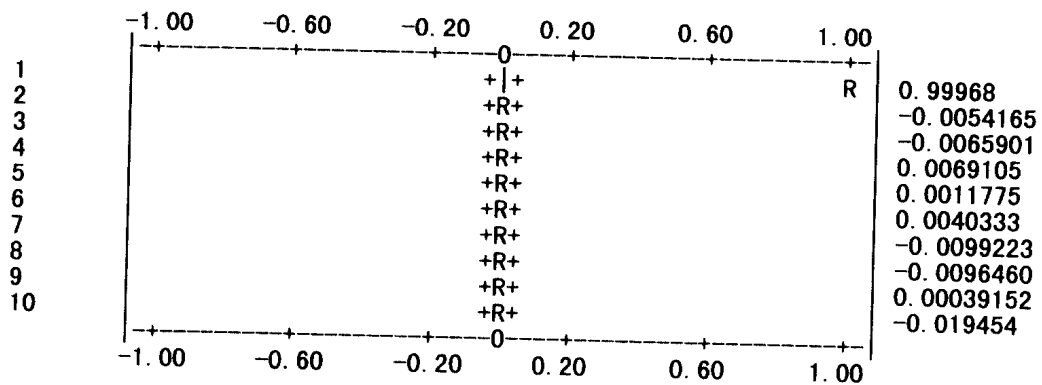
Std. Error = 0.10269426E-01

	Lags					
Autocorrelations		-0.151E-01	-0.483E-02	0.120E-02	0.399E-02	0.338E-01
Standard Errors	1-5	0.152E-01	0.152E-01	0.152E-01	0.152E-01	0.152E-01
Q-statistics		0.988	1.07	1.08	1.15	6.08
Autocorrelations		0.137E-01	-0.945E-02	-0.112E-01	0.296E-01	0.307E-01
Standard Errors	6-10	0.152E-01	0.152E-01	0.152E-01	0.152E-01	0.152E-01
Q-statistics		6.90	7.28	7.82	11.6	15.7
Autocorrelations		-0.279E-01	0.132E-01	0.161E-01	-0.245E-02	0.409E-01
Standard Errors	11-15	0.153E-01	0.153E-01	0.153E-01	0.153E-01	0.153E-01
Q-statistics		19.1	19.8	20.9	21.0	28.2
Autocorrelations		0.443E-02	-0.239E-01	-0.107E-01	0.125E-01	-0.506
Standard Errors	16-20	0.153E-01	0.153E-01	0.153E-01	0.153E-01	0.153E-01
Q-statistics		28.3	30.8	31.3	31.9	0.114E+04

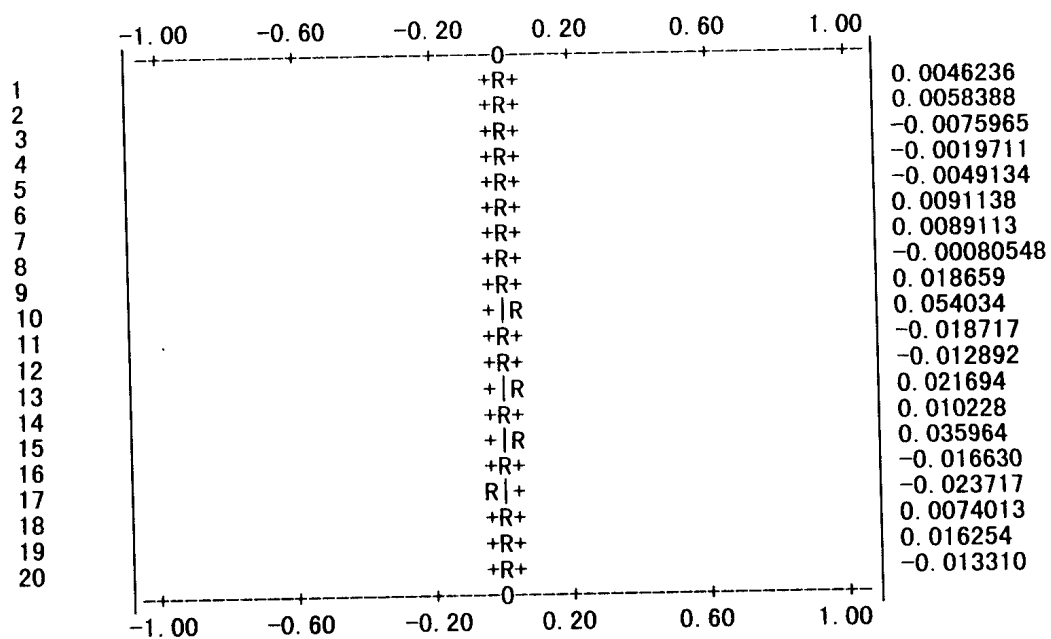
Autocorrelation Function of: X



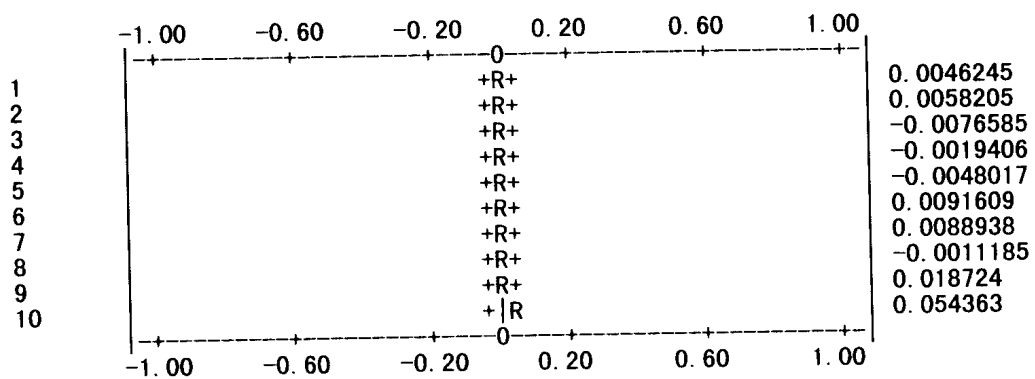
Partial Autocorrelation Function of: X



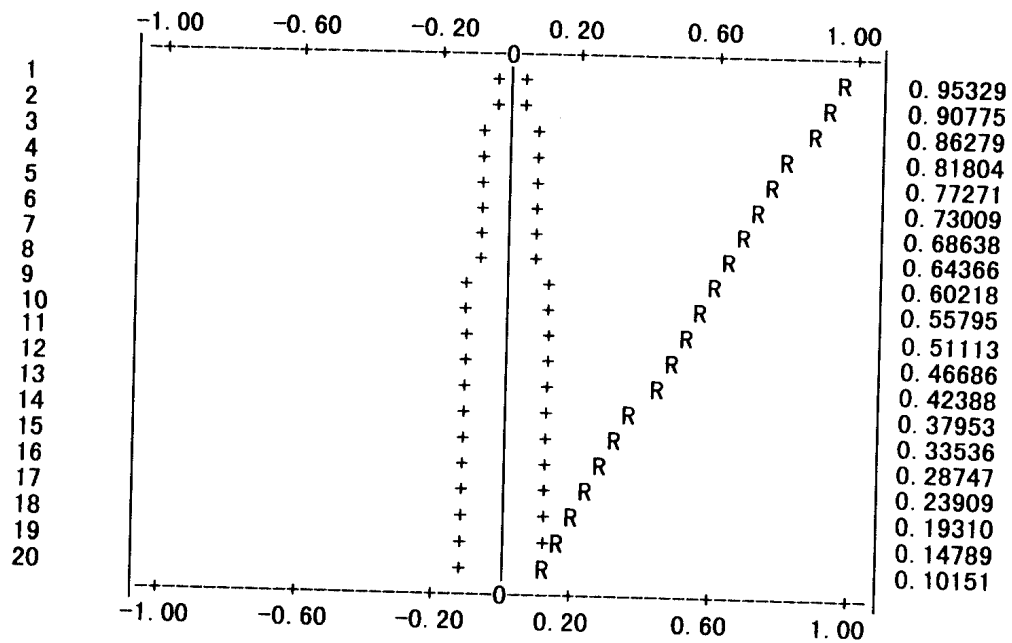
Autocorrelation Function of: $(1-B)X$



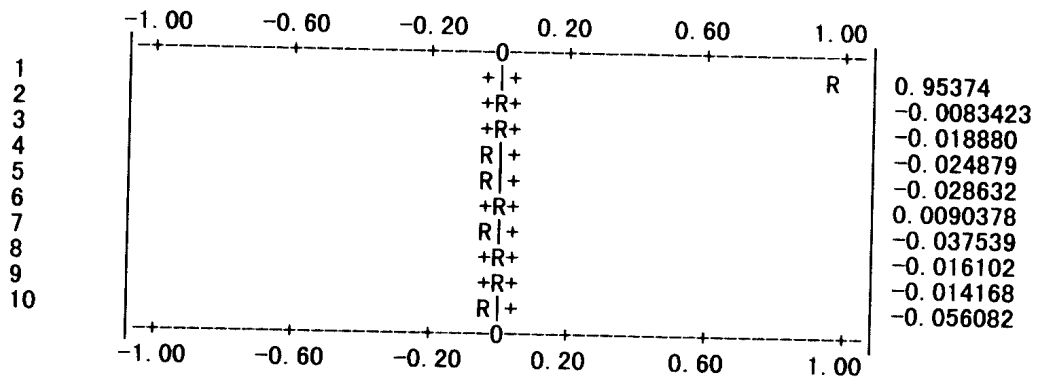
Partial Autocorrelation Function of: $(1-B)X$



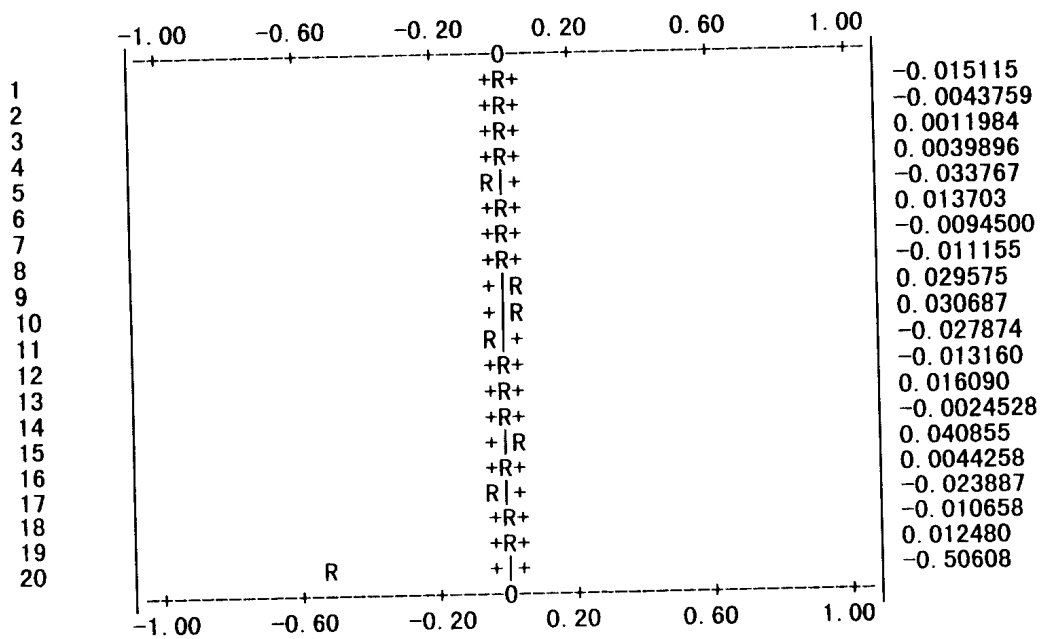
Autocorrelation Function of: $(1-B^{20})X$



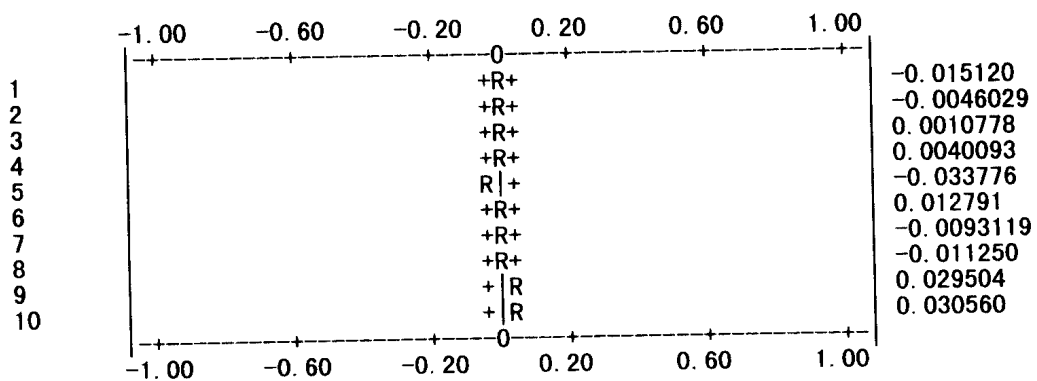
Partial Autocorrelation Function of: $(1-B^{20})X$



Autocorrelation Function of: $(1-B)(1-B^{20})X$



Partial Autocorrelation Function of: $(1-B)(1-B^{20})X$



Box-Jenkins procedures
Procedure BJFRCST

OPTIONS FOR THIS ROUTINE

CONBOUND = 0.95000	CONSTANT = FALSE	EXP = TRUE
NAR = 0	NBACK = 5	NDIFF = 1
NHORIZ = 20	NLAG = 20	NMA = 1
NSAR = 0	NSDIFF = 0	NSMA = 0
NSPAN = 0	ORGBEG = 4342	ORGEND = 4344
PLOT = TRUE	PRINT = TRUE	RETRIEVE = TRUE

TIME SERIES: X

STANDARD ERROR OF THE DISTURBANCE = 0.0072289

THETA(B)

1 + 0.0051974 B

PHI*(B)

1 - B

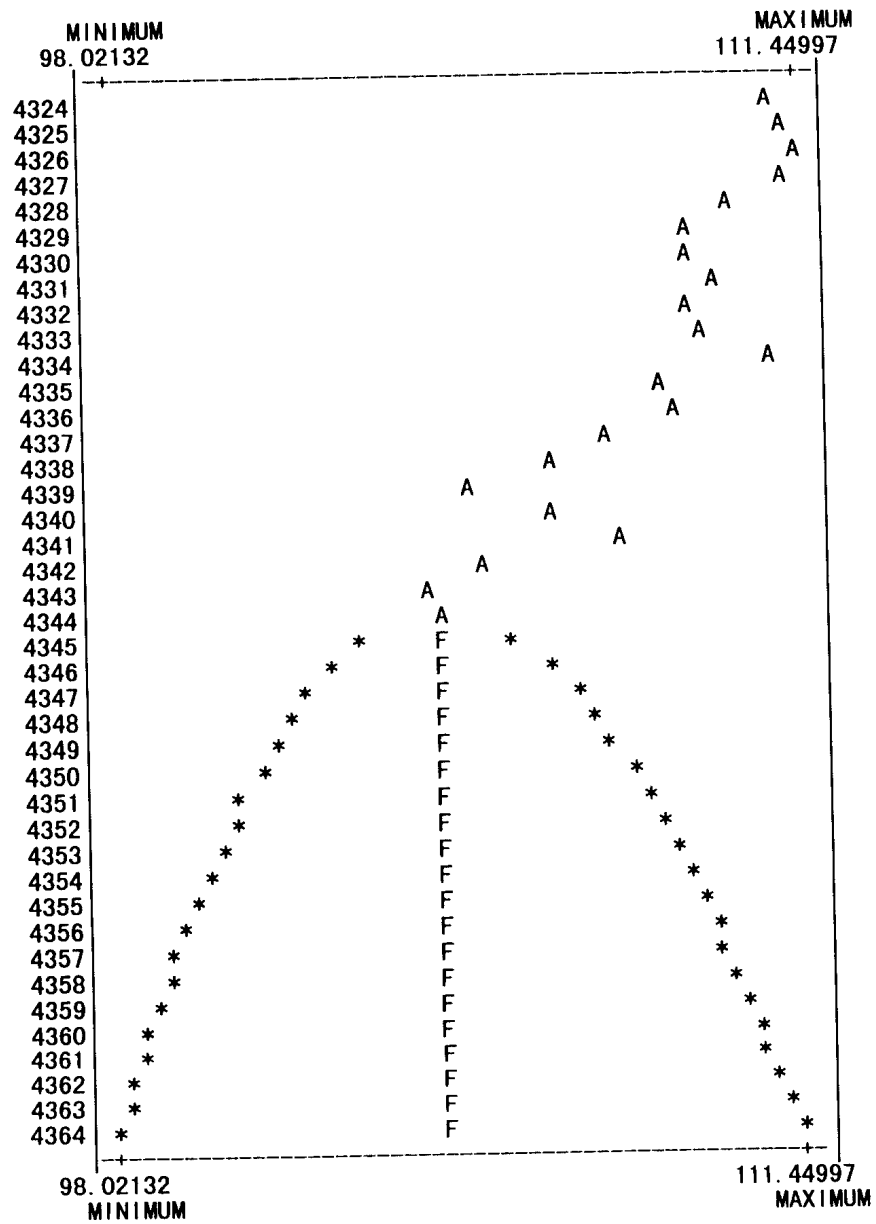
THETA*(B)

1 + 0.0051974 B

Forecasts and 95% Confidence Bounds (Origin = 4344)

	Lowr Bnd	Forecast	Uppr Bnd	Actual	Error
4344	104.41000	104.41000	104.41000	104.41000	0.00000
4345	102.94455	104.41348	105.90338	.	.
4346	102.33954	104.41624	106.53509	.	.
4347	101.87905	104.41900	107.02227	.	.
4348	101.49311	104.42175	107.43491	.	.
4349	101.15473	104.42451	107.79998	.	.
4350	100.85011	104.42727	108.13131	.	.
4351	100.57104	104.43003	108.43708	.	.
4352	100.31220	104.43278	108.72263	.	.
4353	100.06988	104.43554	108.99166	.	.
4354	99.84138	104.43830	109.24687	.	.
4355	99.62467	104.44105	109.49029	.	.
4356	99.41817	104.44381	109.72350	.	.
4357	99.22063	104.44657	109.94775	.	.
4358	99.03103	104.44933	110.16408	.	.
4359	98.84852	104.45208	110.37330	.	.
4360	98.67242	104.45484	110.57613	.	.
4361	98.50212	104.45760	110.77315	.	.
4362	98.33712	104.46036	110.96488	.	.
4363	98.17698	104.46311	111.15175	.	.
4364	98.02132	104.46587	111.33413	.	.

The Series is plotted with "A"
The Forecast is plotted with "F"



Box-Jenkins procedures
Procedure BJFRCST

OPTIONS FOR THIS ROUTINE

CONBOUND = 0.95000	CONSTANT = FALSE	EXP = TRUE
NAR = 0	NBACK = 5	NDIFF = 1
NHORIZ = 20	NLAG = 20	NMA = 2
NSAR = 0	NSDIFF = 0	NSMA = 1
NSPAN = 20	ORGBEG = 4344	ORGEND = 4344
PLOT = TRUE	PRINT = TRUE	RETRIEVE = TRUE

TIME SERIES: X

STANDARD ERROR OF THE DISTURBANCE = 0.0072100

THETA(B)

$$1 + 0.0052920 B + 0.32235 B^2$$

DELTA(B)

$$1 + 0.25300 B$$

PHI*(B)

$$1 - B$$

THETA*(B)

$$1 + 0.0052920 B + 0.32235 B^2 + 0.25300 B^{20} + 0.0013389 B^{21} + 0.081555 B^{22}$$

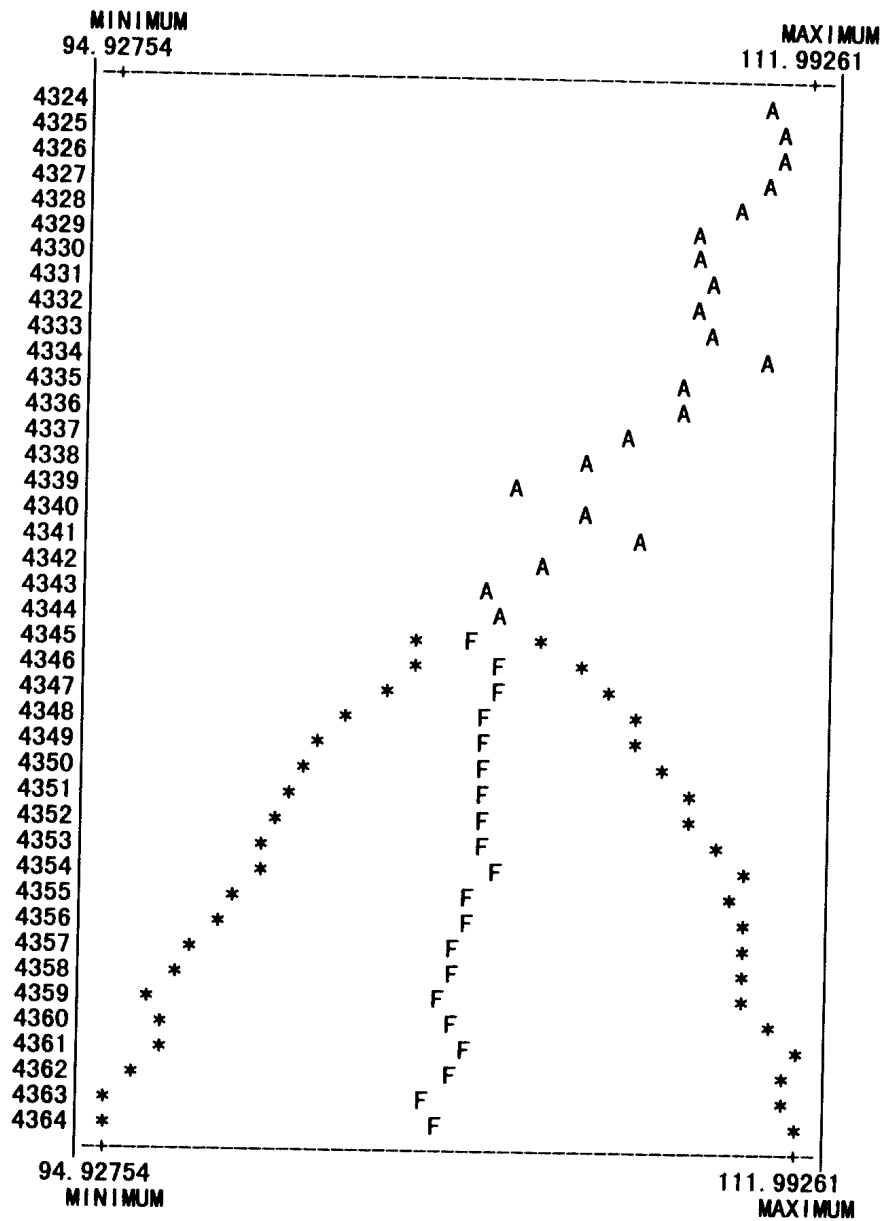
FORECAST STANDARD ERRORS AND PSI WEIGHTS

	STD ERR	PSI
1	0.0072100	1.00529
2	0.010223	1.32764
3	0.014005	1.32764
4	0.016964	1.32764
5	0.019478	1.32764
6	0.021703	1.32764
7	0.023721	1.32764
8	0.025579	1.32764
9	0.027312	1.32764
10	0.028940	1.32764
11	0.030482	1.32764
12	0.031950	1.32764
13	0.033353	1.32764
14	0.034700	1.32764
15	0.035996	1.32764
16	0.037247	1.32764
17	0.038457	1.32764
18	0.039631	1.32764
19	0.040770	1.32764
20	0.041879	1.58064
21	0.043402	1.58198
22	0.044876	1.66354

Forecasts and 95% Confidence Bounds (Origin = 4344)

	Lowr Bnd	Forecast	Uppr Bnd	Actual	Error
4344	104.41000	104.41000	104.41000	104.41000	0.00000
4345	102.43441	103.89223	105.37078	.	.
4346	102.32114	104.39210	106.50497	.	.
4347	101.63748	104.46607	107.37337	.	.
4348	100.79625	104.20394	107.72685	.	.
4349	100.10271	103.99820	108.04529	.	.
4350	99.74637	104.08090	108.60378	.	.
4351	99.45704	104.19011	109.14843	.	.
4352	98.97806	104.06674	109.41704	.	.
4353	98.71108	104.13903	109.86546	.	.
4354	98.68621	104.44572	110.54136	.	.
4355	97.87775	103.90362	110.30048	.	.
4356	97.65244	103.96307	110.68150	.	.
4357	97.06904	103.62656	110.62706	.	.
4358	96.59311	103.39096	110.66721	.	.
4359	96.01098	103.02925	110.56055	.	.
4360	96.24739	103.53650	111.37764	.	.
4361	96.32074	103.86150	111.99262	.	.
4362	95.57304	103.29255	111.63557	.	.
4363	95.02085	102.92541	111.48753	.	.
4364	94.92754	103.04800	111.86312	.	.

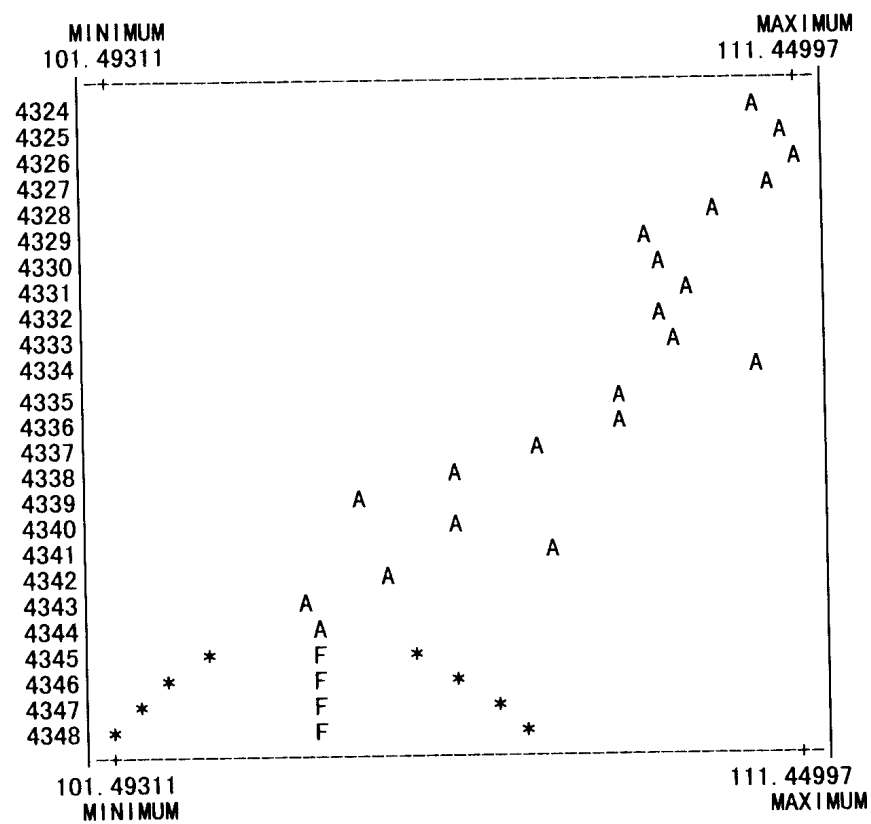
The Series is plotted with "A"
The Forecast is plotted with "F"



Forecasts and 95% Confidence Bounds (Origin = 4344)

	Lowr Bnd	Forecast	Uppr Bnd	Actual	Error
4344	104.41000	104.41000	104.41000	104.41000	0.00000
4345	102.94455	104.41348	105.90338	.	.
4346	102.33954	104.41624	106.53509	.	.
4347	101.87905	104.41900	107.02227	.	.
4348	101.49311	104.42175	107.43491	.	.

The Series is plotted with "A"
The Forecast is plotted with "F"



Box-Jenkins procedures
Procedure BJFRCST

OPTIONS FOR THIS ROUTINE

CONBOUND = 0.95000	CONSTANT = FALSE	EXP = TRUE
NAR = 0	NBACK = 5	NDIFF = 1
NHORIZ = 4	NLAG = 20	NMA = 2
NSAR = 0	NSDIFF = 0	NSMA = 1
NSPAN = 20	ORGBEG = 4344	ORGEND = 4344
PLOT = TRUE	PRINT = TRUE	RETRIEVE = TRUE

TIME SERIES: X

STANDARD ERROR OF THE DISTURBANCE = 0.0072100

THETA(B)

$$1 + 0.0052920 B + 0.0032235 B^2$$

DELTA(B)

$$1 + 0.25300 B$$

PHI*(B)

$$1 - B$$

THETA*(B)

$$1 + 0.0052920 B + 0.0032235 B^2 + 0.25300 B^{20} + 0.0013389 B^{21} + 0.00081555 B^{22}$$

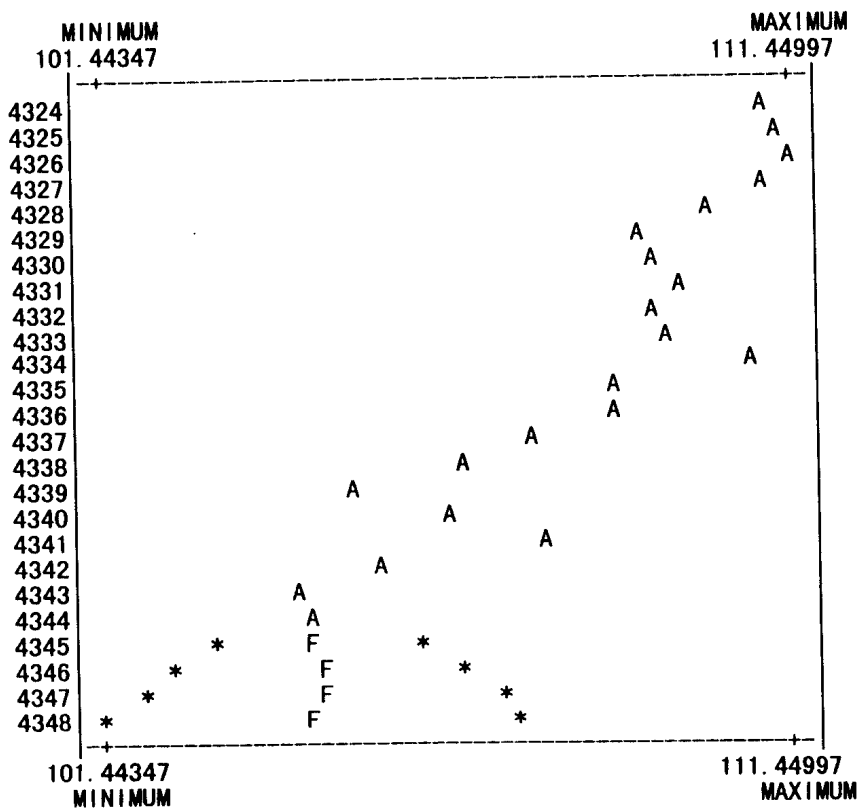
FORECAST STANDARD ERRORS AND PSI WEIGHTS

	STD ERR	PSI
1	0.0072100	1.00529
2	0.010223	1.00852
3	0.012546	1.00852
4	0.014501	1.00852
5	0.016222	1.00852
6	0.017777	1.00852
7	0.019206	1.00852
8	0.020537	1.00852
9	0.021786	1.00852
10	0.022967	1.00852
11	0.024091	1.00852
12	0.025164	1.00852
13	0.026294	1.00852
14	0.027185	1.00852
15	0.028140	1.00852
16	0.029064	1.00852
17	0.029960	1.00852
18	0.030830	1.00852
19	0.031676	1.00852
20	0.032500	1.26152
21	0.033749	1.26285
22	0.034955	1.26367

Forecasts and 95% Confidence Bounds (Origin = 4344)

	Lowr Bnd	Forecast	Uppr Bnd	Actual	Error
4344	104.41000	104.41000	104.41000	104.41000	0.00000
4345	103.06200	104.52874	106.01636	.	.
4346	102.48611	104.56041	106.67669	.	.
4347	102.09104	104.63247	107.23717	.	.
4348	101.44347	104.36791	107.37666	.	.

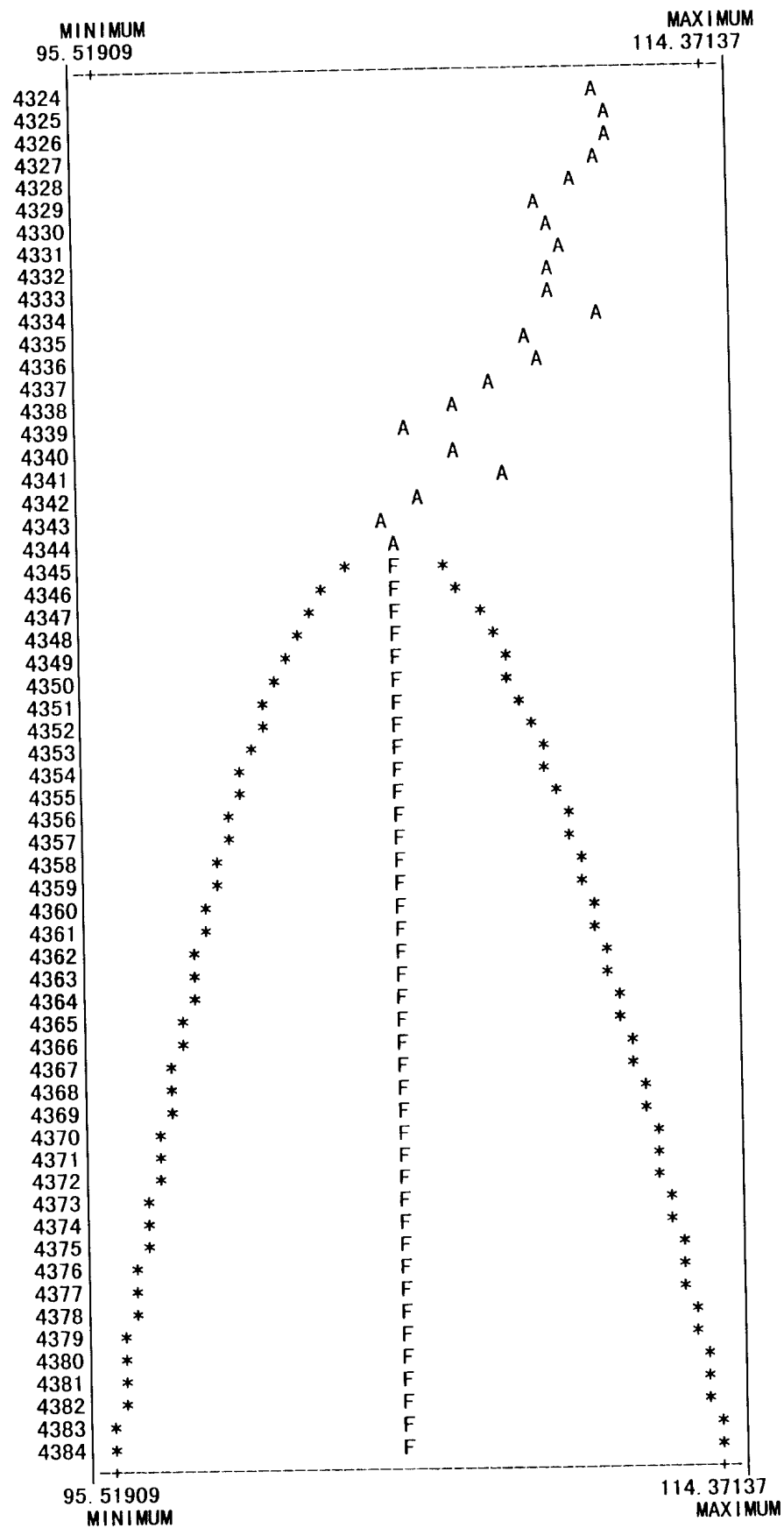
The Series is plotted with "A"
 The Forecast is plotted with "F"



Forecasts and 95% Confidence Bounds (Origin = 4344)

	Lowr Bnd	Forecast	Uppr Bnd	Actual	Error
4344	104.41000	104.41000	104.41000	104.41000	0.00000
4345	102.94455	104.41348	105.90338	.	.
4346	102.33954	104.41624	106.53509	.	.
4347	101.87905	104.41900	107.02227	.	.
4348	101.49311	104.42175	107.43491	.	.
4349	101.15473	104.42451	107.79998	.	.
4350	100.85011	104.42727	108.13131	.	.
4351	100.57104	104.43003	108.43708	.	.
4352	100.31220	104.43278	108.72263	.	.
4353	100.06988	104.43554	108.99166	.	.
4354	99.84138	104.43830	109.24687	.	.
4355	99.62467	104.44105	109.49029	.	.
4356	99.41817	104.44381	109.72350	.	.
4357	99.22063	104.44657	109.94775	.	.
4358	99.03103	104.44933	110.16408	.	.
4359	98.84852	104.45208	110.37330	.	.
4360	98.67242	104.45484	110.57613	.	.
4361	98.50212	104.45760	110.77315	.	.
4362	98.33712	104.46036	110.96488	.	.
4363	98.17698	104.46311	111.15175	.	.
4364	98.02132	104.46587	111.33413	.	.
4365	97.86981	104.46863	111.51237	.	.
4366	97.72216	104.47139	111.68676	.	.
4367	97.57809	104.47415	111.85756	.	.
4368	97.43740	104.47691	112.02499	.	.
4369	97.29985	104.47966	112.18928	.	.
4370	97.16527	104.48242	112.35060	.	.
4371	97.03348	104.48518	112.50913	.	.
4372	96.90434	104.48794	112.66502	.	.
4373	96.77769	104.49070	112.81842	.	.
4374	96.65342	104.49346	112.96944	.	.
4375	96.53139	104.49621	113.11821	.	.
4376	96.41152	104.49897	113.26484	.	.
4377	96.29368	104.50173	113.40943	.	.
4378	96.17781	104.50449	113.55207	.	.
4379	96.06379	104.50725	113.69284	.	.
4380	95.95156	104.51001	113.83184	.	.
4381	95.84104	104.51277	113.96912	.	.
4382	95.73217	104.51553	114.10476	.	.
4383	95.62487	104.51829	114.23882	.	.
4384	95.51909	104.52105	114.37137	.	.

The Series is plotted with "A"
The Forecast is plotted with "F"



Forecasts and 95% Confidence Bounds (Origin = 1999: 9)

	Lowr Bnd	Forecast	Uppr Bnd	Actual	Error
1999: 9	107.75001	107.75001	107.75001	107.75001	0.00000
1999: 10	100.72694	106.52266	112.65186	.	.
1999: 11	96.73169	106.61040	117.49798	.	.

The Series is plotted with "A"
The Forecast is plotted with "F"

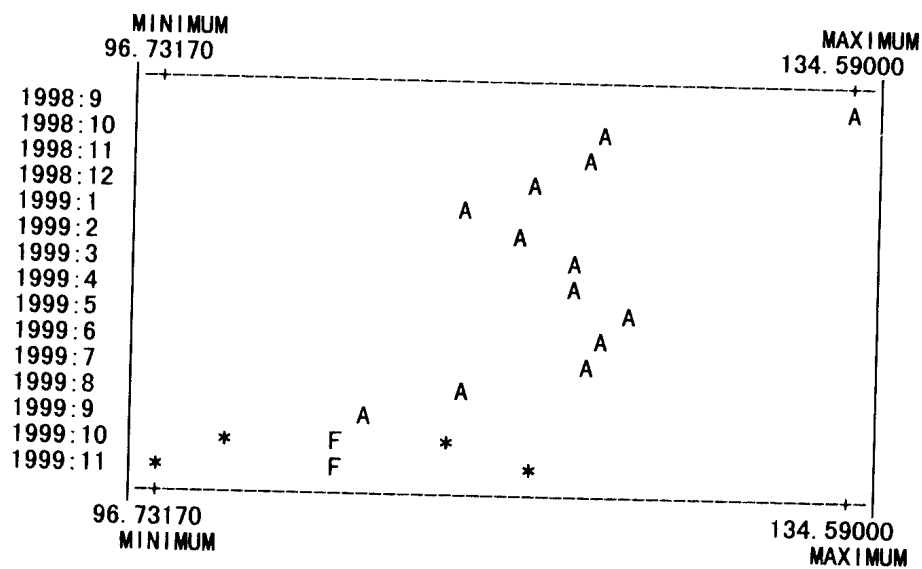


Table 1

Differences of forecasting accuracy by Box-Jenkins procedures between with monthly data and with daily data

data preriod: monthly data; 1986: 1—1999: 8

daily data; 1983: 1: 3—1999: 9: 24 (1-4344)

Forecast and 95% Confidence Bounds; unit = yen

Forecasting period	model	monthly	daily	differences
September	without parameters	N.A	5.94	5.94
	with parameters	N.A	5.94	5.94
Octorber	without parameters	21.51	14.58	6.93
	with parameters	18.88	19.40	-0.52
Nobember	without parameters	27.81	18.85	8.96
	with parameters	27.44	17.51	9.93
December	without parameters	32.96	23.12	9.78
	with parameters	33.54	23.17	10.37
January(in 2000)	without parameters	37.44	26.72	10.72
	with parameters	37.99	26.79	11.20
Feburary	without parameters	41.46	29.92	11.47
	with parameters	43.53	29.99	13.54
May	without parameters	51.81	40.34	11.74
	with parameters	58.33	40.45	17.88
August	without parameters	60.60	46.74	13.86
	with parameters	66.30	46.88	19.42
<hr/>				
one month	without parameters	11.92	13.31	-1.39
	with parameters	11.74	16.93	-5.19
two months	without parameters	20.77	18.85	1.92
	with parameters	19.75	17.51	2.24
three months	without parameters	26.88	23.12	3.76
	with parameters	28.88	23.17	5.71
four months	without parameters	31.87	26.72	5.15
	with parameters	34.09	26.79	7.30
five months	without parameters	36.12	29.92	6.29
	with parameters	40.41	29.99	10.42
six months	without parameters	40.11	32.82	7.29
	with parameters	46.48	32.70	13.78
nine months	without parameters	50.16	40.34	9.82
	with parameters	60.76	40.45	20.31
twelve months (one year)	without parameters	58.67	46.74	11.93
	with parameters	65.77	46.88	18.89

data sources; Oriental Economist Co., "exchange-rate; inerest-rate; CD-ROM", 1998, "Economate-W, monthly data-files, 1999: 8, 9,10 Nikkei (Japanese economy newspapers co.) telecom.21, —internet-data, 1999: 9: 20~24.

Note(1) We have utilized daily data up to the 24th September 1999, therefore, there are not a complete monthly data of September 1999 (the first part of the Table 1), however, we have been able to compute the average of daily data of 16 points in September 1999 as an approximate of monthly data for September 1999 to forecast for the period from the October 1999 to September 2000. (the results of the second part of the Table 1)

Note

- (1) The Oriental Economist Publishing, Economate-W, macrodata files, monthly data, FD, 1999:7, 8, 9, 10. Nikkei telecom. 21, daily data, internet.
- (2) The Oriental Economist Publishing, "The exchange-rates & the rate of interest," CD-ROM for Windows 95, 1998. Nikkei telecom. 21, daily data, internet.
- (3) TSP Japan, TSP. V. 44, 1998.
- (4) T. Minotani & T. Hiromatsu, Econometrics, Taga Publishing, 1997.
- (5) T. Minotani & T. Hiromatsu, op. cit.
- (6) T. Minotani & others, The Quantitative Analyses by P. C., Taga Publishing, 1997
- (7) The Oriental Economist Publishing, CD-ROM, op. cit., Nikkei telecom. 21, internet.
- (8) The Oriental Economist Publishing, Economate-W, Monthly data files, August, September & October 1999, Nikkei, telecom. 21, internet.
- (9) T. Minotani & T. Hiromatsu, op. cit.
T. Minotani & others, op. cit. definition of variable; $x = \log(yj)$. yj = yen – dollar spot exchange – rate in Tokyo market.

3. On account of using daily data, we have achieved fairly clear increases in forecasting precision with 95% confidence bounds by Box-Jenkins Method, but it seems to be rather difficult to find out such long series of reliable daily data from the 3rd January 1983 to the 24th⁽¹⁾ September 1999 on other economic data, for example, the differences of short term interest-rates between in Japan and in the U. S.

On the other hand, we can rather easily use various sorts of monthly data⁽²⁾ different from yen-dollar exchange-rates, therefore, we intend to try to excute arch model⁽³⁾ (autoregressive conditionally heteroskedastic), because the variances of yen-dollar rates are naturally not the same, arch model would have more robust parameters than Box-Jenkins procedures.

Firstly, we have carry out arch computation⁽⁴⁾ by using only daily data on yen-dollar rates and time trend. In the second part of this section (Section 3), we have calculated arch model by monthly data on exchange-rates and the differences of three months' interest-rates between in Japan and in the U. S.⁽⁵⁾⁽⁶⁾ (DIUJ).

Current sample: 1 to 4344
Current sample: 1 to 4344

Equation 1

ARCH ESTIMATION

OPTIONS FOR THIS ROUTINE

E2INIT = HINIT	GT =	HEXP = 0.50000
HINT = SSR	MEAN = FALSE	NAR = 4
NMA = 0	RELAX = FALSE	UNCOND = FALSE
ZERO = TRUE		

Working space used: 71523

STARTING VALUES

	C	T	ALPHA0	ALPHA1
VALUE	5.34512	-0.00018434	0.028359	0.00000

	ALPHA2	ALPHA3	ALPHA4
VALUE	0.00000	0.00000	0.00000

F = -1574.6	FNEW = -2348.7	ISQZ = 3	STEP = 0.12500	CRIT = 31611.
F = 2348.7	FNEW = -3149.6	ISQZ = 3	STEP = 0.12500	CRIT = 22120.
F = 3149.6	FNEW = -3505.8	ISQZ = 6	STEP = 0.15625E-01	CRIT = 26630.
F = -3505.8	FNEW = -3516.8	ISQZ = 0	STEP = 1.0000	CRIT = 298.64
F = -3516.8	FNEW = -3566.1	ISQZ = 6	STEP = 0.15625E-01	CRIT = 12262.
F = -3566.1	FNEW = -3960.1	ISQZ = 3	STEP = 0.12500	CRIT = 4360.6
F = -3960.1	FNEW = -3978.0	ISQZ = 0	STEP = 1.0000	CRIT = 130.70
F = -3978.0	FNEW = -4023.8	ISQZ = 3	STEP = 0.12500	CRIT = 316.14
F = -4023.8	FNEW = -4120.3	ISQZ = 1	STEP = 0.50000	CRIT = 199.00
F = -4120.3	FNEW = -4145.2	ISQZ = 0	STEP = 1.0000	CRIT = 111.67
F = -4145.2	FNEW = -4247.6	ISQZ = 2	STEP = 0.25000	CRIT = 409.47
F = -4247.6	FNEW = -4298.8	ISQZ = 9	STEP = 0.19531E-02	CRIT = 34905.
F = -4298.8	FNEW = -4299.3	ISQZ = 9	STEP = 0.19531E-02	CRIT = 21214.
F = -4299.3	FNEW = -4324.0	ISQZ = 2	STEP = 0.25000	CRIT = 299.28
F = -4324.0	FNEW = 7100.2	ISQZ = 11	STEP = 0.48828E-03	CRIT = 0.18015E+08

	C	T	ALPHA0	ALPHA1
ESTIMATE	5.16338	-0.00012795	0.000023163	0.82014
CHANGES	1649.67844	-1.59574	-0.0034218	-46.06724

	ALPHA2	ALPHA3	ALPHA4
ESTIMATE	0.00000	0.22938	0.00000
CHANGES	0.00000	-5.10249	0.00000

87 FUNCTION EVALUATIONS.

Dependent variable: X

Current sample: 1 to 4344

Number of observations: 4344

(Statistics based on transformed data)

Mean of dep. var. = 5.09176

Std. dev. of dep. var. = .099746

Sum of squared residuals = 106.546

Variance of residuals = .024539

Std. error of regression = .156648

R-squared = .663496

Adjusted R-squared = .663419

Durbin-Watson = .223986E-02 [<.000]

Jarque-Bera test = 1210.91 [.000]

(Statistics based on original data)

Mean of dep. var. = 4.94465

Std. dev. of dep. var. = .286028

Sum of squared residuals = 30140.1

Variance of residuals = 6.94153

Std. error of regression = 2.63468

R-squared = .653284

Adjusted R-squared = .653204

Durbin-Watson = .784869E-05

Log likelihood = 4323.96

Number of observations in LogL = 4344

Initial observations dropped = 0

Est. initial values for H(t) = 0

Initial values for H(t) = 6.9383

Standard Parameter	Estimate	Error	t-statistic	P-value
C	5.16338	.120038E-02	4301.44	[.000]
T	-.127952E-03	0.	0.	[1.00]
ALPHA0	.231632E-04	.438184E-05	5.28618	[.000]
ALPHA1	.820137	.057018	14.3837	[.000]
ALPHA2	0.	0.	0.	[1.00]
ALPHA3	.229382	.059971	3.82490	[.000]
ALPHA4	0.	0.	0.	[1.00]

Current sample: 1988: 1 to 1999: 8 Equation 1
Current sample: 1988: 1 to 1999: 8
Current sample: 1988: 1 to 1999: 8 ARCH ESTIMATION

OPTIONS FOR THIS ROUTINE

E2INIT = HINIT GT = HEXP = 0.50000
HINT = SSR MEAN = FALSE NAR = 4
NMA = 0 RELAX = FALSE UNCOND = FALSE
ZERO = TRUE

Working space used: 4259

		STARTING VALUES		
	C	DIUJ	ALPHA0	ALPHA1
VALUE	127.45754	-1.99510	227.35931	0.00000

	ALPHA2	ALPHA3	ALPHA4
VALUE	0.00000	0.00000	0.00000

F = 578.51	FNEW = 570.56	ISQZ = 6	STEP = 0.15625E-01	CRIT = 6684.8
F = 570.56	FNEW = 562.87	ISQZ = 1	STEP = 0.50000	CRIT = 132.06
F = 562.87	FNEW = 551.05	ISQZ = 4	STEP = 0.62500E-01	CRIT = 459.96
F = 551.05	FNEW = 546.94	ISQZ = 4	STEP = 0.62500E-01	CRIT = 62.456
F = 546.94	FNEW = 528.44	ISQZ = 4	STEP = 0.62500E-01	CRIT = 507.84
F = 528.44	FNEW = 521.00	ISQZ = 0	STEP = 1.0000	CRIT = 19.009
F = 521.00	FNEW = 519.80	ISQZ = 1	STEP = 0.50000	CRIT = 8.6013
F = 519.80	FNEW = 518.63	ISQZ = 0	STEP = 1.0000	CRIT = 1.9653
F = 518.63	FNEW = 518.48	ISQZ = 0	STEP = 1.0000	CRIT = 0.27756
F = 518.48	FNEW = 518.47	ISQZ = 0	STEP = 1.0000	CRIT = 0.14171E-01
F = 518.47	FNEW = 518.47	ISQZ = 0	STEP = 1.0000	CRIT = 0.55220E-04
F = 518.47	FNEW = 518.47	ISQZ = 0	STEP = 1.0000	CRIT = 0.88828E-09

CONVERGENCE ACHIEVED AFTER 12 ITERATIONS

44 FUNCTION EVALUATIONS.

Dependent variable: YJ

Current sample: 1988: 1 to 1999: 8

Number of observations: 140

(Statistics based on transformed data)

Mean of dep. var. = 125.070

Std. dev. of dep. var. = 7.85166

Sum of squared residuals = 4894.90

Variance of residuals = 35.4703

Std. error of regression = 5.95569

R-squared = .436649

Adjusted R-squared = .432567

Durbin-Watson = .310954 [.000,.000]

Jarque-Bera test = 11.0947 [.004]

(Statistics based on original data)

Mean of dep. var. = 121.654

Std. dev. of dep. var. = 15.8531

Sum of squared residuals = 33048.1

Variance of residuals = 239.479

Std. error of regression = 15.4751

R-squared = .088836

Adjusted R-squared = .082233

Durbin-Watson = .054882

Log likelihood = -518.472

Number of observations in LogL = 140

Initial observations dropped = 0

Est. initial values for H(t) = 0

Initial values for H(t) = 236.06

Parameter	Estimate	Standard Error	t-statistic	P-value
C	130.865	.998959	131.001	[.000]
DIUJ	-2.16152	.547847	-3.94548	[.000]
ALPHA0	8.57996	2.70730	3.16919	[.002]
ALPHA1	.972070	.061296	15.8586	[.000]
ALPHA2	0.	0.	0.	[1.00]
ALPHA3	0.	0.	0.	[1.00]
ALPHA4	0.	0.	0.	[1.00]

Standard Errors computed from analytic first and second derivatives(Eicker-White)

Equation 2

ARCH ESTIMATION

OPTIONS FOR THIS ROUTINE

E2INIT = HINIT	GT =	HEXP = 0.50000
HINT = SSR	MEAN = FALSE	NAR = 4
NMA = 0	RELAX = FALSE	UNCOND = FALSE
ZERO = TRUE		

Working space used: 4259

STARTING VALUES

	C	DIUJ	ALPHA0	ALPHA1
VALUE	130.86472	-2.16152	8.57996	0.020000
	ALPHA2	ALPHA3	ALPHA4	
VALUE	0.00000	0.00000	0.00000	

F =1245.9	FNEW = 957.25	ISQZ = 0	STEP = 1.0000	CRIT = 426.16
F = 957.25	FNEW = 778.74	ISQZ = 0	STEP = 1.0000	CRIT = 263.48
F = 778.74	FNEW = 665.76	ISQZ = 0	STEP = 1.0000	CRIT = 162.30
F = 665.76	FNEW = 594.89	ISQZ = 0	STEP = 1.0000	CRIT = 96.571
F = 594.89	FNEW = 545.60	ISQZ = 0	STEP = 1.0000	CRIT = 56.981
F = 545.60	FNEW = 524.77	ISQZ = 2	STEP = 0.25000	CRIT = 75.697
F = 524.77	FNEW = 520.98	ISQZ = 0	STEP = 1.0000	CRIT = 17.982
F = 520.98	FNEW = 519.50	ISQZ = 0	STEP = 1.0000	CRIT = 5.4689
F = 519.50	FNEW = 519.01	ISQZ = 4	STEP = 0.62500E-01	CRIT = 9.9181
F = 519.01	FNEW = 518.59	ISQZ = 0	STEP = 1.0000	CRIT = 1.2353
F = 518.59	FNEW = 518.48	ISQZ = 0	STEP = 1.0000	CRIT = 0.21715
F = 518.48	FNEW = 518.47	ISQZ = 0	STEP = 1.0000	CRIT = 0.68967E-02
F = 518.47	FNEW = 518.47	ISQZ = 0	STEP = 1.0000	CRIT = 0.12325E-04
F = 518.47	FNEW = 518.47	ISQZ = 0	STEP = 1.0000	CRIT = 0.43289E-10

CONVERGENCE ACHIEVED AFTER 14 ITERATIONS

34 FUNCTION EVALUATIONS.

Dependent variable: YJ

Current sample: 1988: 1 to 1999: 8

Number of observations: 140

(Statistics based on transformed data)

Mean of dep. var. = 125.070

Std. dev. of dep. var. = 7.85166

Sum of squared residuals = 4894.90

Variance of residuals = 35.4703

Std. error of regression = 5.95569

R-squared = .436649

Adjusted R-squared = .432567

Durbin-Watson = .310954 [.000,.000]

Jarque-Bera test = 11.0947 [.004]

(Statistics based on original data)

Mean of dep. var. = 121.654

Std. dev. of dep. var. = 15.8531

Sum of squared residuals = 33048.1

Variance of residuals = 239.479

Std. error of regression = 15.4751

R-squared = .088836

Adjusted R-squared = .082233

Durbin-Watson = .054882

Log likelihood = -518.472

Number of observations in LogL = 140

Initial observations dropped = 0

Est. initial values for H(t) = 0

Initial values for H(t) = 236.06

Parameter	Estimate	Standard Error	t-statistic	P-value
C	130.865	.998959	131.001	[.000]
DIUJ	-2.16152	.547847	-3.94548	[.000]
ALPHA0	8.57996	2.70730	3.16919	[.002]
ALPHA1	.972070	.061296	15.8586	[.000]
ALPHA2	0.	0.	0.	[1.00]
ALPHA3	0.	0.	0.	[1.00]
ALPHA4	0.	0.	0.	[1.00]

Standard Errors computed from analytic first and second derivatives(Eicker-White)

Equation 3

GARCH ESTIMATION

OPTIONS FOR THIS ROUTINE

E2INIT = HINIT	GT =	HEXP = 0.50000
HINT = SSR	MEAN = FALSE	NAR = 1
NMA = 0	RELAX = FALSE	UNCOND = FALSE
ZERO = TRUE		

Working space used: 2777

STARTING VALUES

	C	DIUJ	ALPHA0	ALPHA1	BETA1
VALUE	127.45754	-1.99510	227.35931	0.00000	0.00000
F = 578.51	FNEW = 560.48	ISQZ = 4	STEP = 0.62500E-01	CRIT = 267.86	
F = 560.48	FNEW = 546.90	ISQZ = 8	STEP = 0.39063E-02	CRIT = 3398.6	
F = 546.90	FNEW = 539.90	ISQZ = 6	STEP = 0.15625E-01	CRIT = 574.78	
F = 539.90	FNEW = 530.05	ISQZ = 0	STEP = 1.0000	CRIT = 14.723	
F = 530.05	FNEW = 523.79	ISQZ = 0	STEP = 1.0000	CRIT = 15.034	
F = 523.79	FNEW = 520.22	ISQZ = 3	STEP = 0.12500	CRIT = 34.633	
F = 520.22	FNEW = 518.59	ISQZ = 0	STEP = 1.0000	CRIT = 3.8908	
F = 518.59	FNEW = 518.47	ISQZ = 0	STEP = 1.0000	CRIT = 0.22416	
F = 518.47	FNEW = 518.47	ISQZ = 0	STEP = 1.0000	CRIT = 0.30655E-02	
F = 518.47	FNEW = 518.47	ISQZ = 0	STEP = 1.0000	CRIT = 0.25023E-05	

CONVERGENCE ACHIEVED AFTER 10 ITERATIONS

41 FUNCTION EVALUATIONS.

Dependent variable: YJ

Current sample: 1988: 1 to 1999: 8

Number of observations: 140

(Statistics based on transformed data)

Mean of dep. var. = 125.070

Std. dev. of dep. var. = 7.85166

Sum of squared residuals = 4894.90

Variance of residuals = 35.4703

Std. error of regression = 5.95569

R-squared = .436649

Adjusted R-squared = .432567

Durbin-Watson = .310954 [.000,.000]

Jarque-Bera test = 11.0947 [.004]

(Statistics based on original data)

Mean of dep. var. = 121.654

Std. dev. of dep. var. = 15.8531

Sum of squared residuals = 33048.1

Variance of residuals = 239.479

Std. error of regression = 15.4751

R-squared = .088836

Adjusted R-squared = .082233

Durbin-Watson = .054882

Log likelihood = -518.472

Number of observations in LogL = 140

Initial observations dropped = 0

Est. initial values for H(t) = 0

Initial values for H(t) = 236.06

Parameter	Estimate	Standard Error	t-statistic	P-value
C	130.865	.998958	131.001	[.000]
DIUJ	-2.16152	.547847	-3.94548	[.000]
ALPHA0	8.57995	2.70730	3.16919	[.002]
ALPHA1	.972070	.061296	15.8586	[.000]
BETA1	0.	0.	0.	[1.00]

Standard Errors computed from analytic first and second derivatives(Eicker-White)

Equation 7

Method of estimation = Ordinary Least Squares

Dependent variable: X

Current sample: 1988: 1 to 1999: 8

Number of observations: 140

Mean of dep. var. = 4.79244	LM het. test = 9.65445 [.002]
Std. dev. Of dep. var. = .134090	Durbin-Watson = .060016 [.000,.000]
Sum of squared residuals = 1.99806	Jarque-Bera test = 4.21346 [.122]
Varince of residuals = .014584	Ramsey's RESET2 = 141.138 [.000]
Std. error of regression = .120766	F (zero slopes) = 17.1827 [.000]
R-squared = .200539	Schwarz B. I. C. = -4.14357
Adjusted R-squared = .188868	Log likelihood = 98.8113

Variable	Estimated Coefficient	Standard Error	t-statistic	P-value
C	4.89935	.020907	234.337	[.000]
T	-.129001E-02	.294517E-03	-4.38010	[.000]
DIUJ	-.548589E-02	.504371E-02	-1.08767	[.279]

Equation 8

Method of estimation Ordinary Least Squares

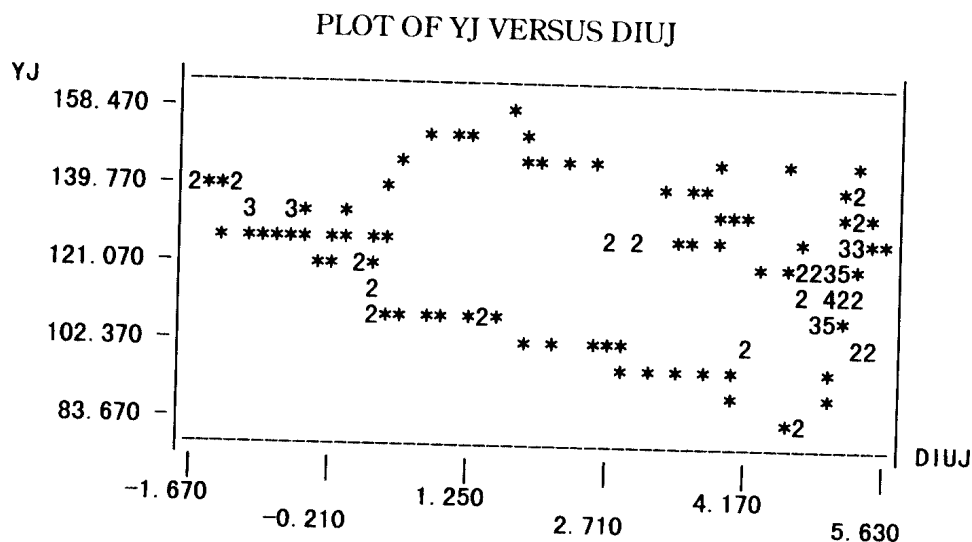
Dependent variable: YJ

Current sample: 1988: 1 to 1999: 8

Number of observations: 140

Mean of dep. var. = 121.654	LM het. test = 7.43546 [.006]
Std. dev. Of dep. var. = 15.8531	Durbin-Watson = .064499 [.000,.000]
Sum of squared residuals = 27460.4	Jarque-Bera test = .948306 [.622]
Varince of residuals = 200.441	Ramsey's RESET2 = 124.826 [.000]
Std. error of regression = 14.1577	F (zero slopes) = 18.6422 [.000]
R-squared = .213928	Schwarz B. I. C. = 5.38475
Adjusted R-squared = .202453	Log likelihood = -568.171

Variable	Estimated Coefficient	Standard Error	t-statistic	P-value
C	134.692	2.45101	54.9534	[.000]
T	-.161215	.034527	-4.66922	[.000]
DIUJ	-.574767	.591288	-.972059	[.333]



Note

- (1) The Oriental Economist Publishing, CD-ROM, op. cit. Nikkei telecom. 21, op. cit.
- (2) The Oriental Economist Publishing, Economate-W, op. cit.
- (3) H. Wago & K. Ban, op. cit.
- (4) TSP. Japan, TSP. V. 44, 1998.
- (5) The Oriental Economist Publishing, Economate-W, op. cit.
- (6) T. Hiromatsu & N. Fujiwara, Practices of Econometrics, Shinsei-Sha, 1990.

4. In order to well explain very serious fluctuations of yen-dollar exchange-rates in 1990s which have been one of key-causes of fairly abrupt losses of the very strong vitalities in our economy for nearly about more than forty years since the Second World War, we have used Box-Jenkins procedures⁽¹⁾ and arch models⁽²⁾ by both daily⁽³⁾ and monthly data. As for Box-Jenkins forecast, we could improve very clearly 95% confidence bounds by using daily data more precisely than by monthly data, however, for arch estimations, daily data are not enough to execute various arch process, therefore, we have merely carried out a standard arch, Garch (1,1), GARCH = M and OLS-M⁽⁴⁾ by using only monthly data. In examining many meaningful econometric approaches and empirical evidences in papers just like the two articles shown in our notes⁽⁵⁾, we cannot but have the strong impressions that we need to make great progress as hard as we can in the fields of econometric researches on the exchange markets. But on the other hand, whatever we could realize to make progresses on forecasting level of yen-dollar rates in near future for about five or ten years, there would remain always the risks of abrupt large changes of yen-dollar exchange-rates which would give various instable impacts on our economy and on Asian countries⁽⁶⁾, so we have to con-

clude once again that it would absolutely necessary to intervene corporately on the occasions of necessity. At the end of this paper we intend to represent the purchasing power parities of Japan and the U. S. for the long period from the first quarter in 1973 to the fourth quarter in 1998. A close and detailed examinations of the PPP based on the Japan's export price-index in yen and the U. S. export deflator, would tend to show that the spot yen-dollar exchange rates are inclined

REXR : real yen – dollar rates = the spot yen – dollar rate X (US producers' price index / Japan's wholesale price index)

RUSINTL = US 10 years Bonds' return – % increase in US GDP deflator

RJINTL = Japan's 10 years Bonds' return – % increase in Japan's GDP deflator OLS

FASSETC = (Cumulated Current Balance of Payment-Cumulated Direct investment-Reserves for foreign currencies) / Japan's hominal GDP.

$$\begin{array}{rcll} \text{REXR} = & .937117 & +.036843 (\text{RUSINTL (2)} - \text{RJINTL (2)}) & -.076798 \text{ FASSETC (4)} \\ & (29.96) & (5.67) & (-1.94) \end{array}$$

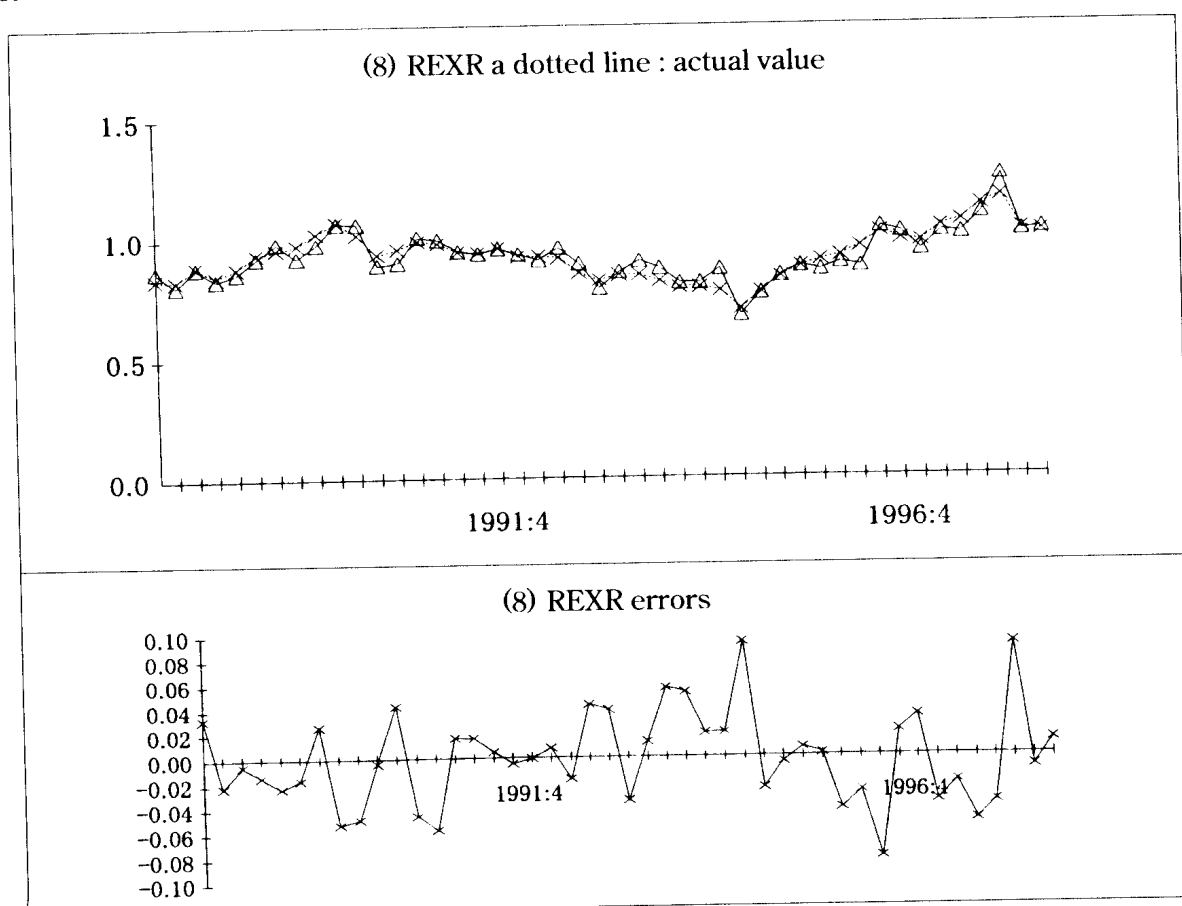
$$\bar{R}^2 = 0.4082 \quad S = 0.075 \quad DW = 0.308$$

Cochrane-Orcutt

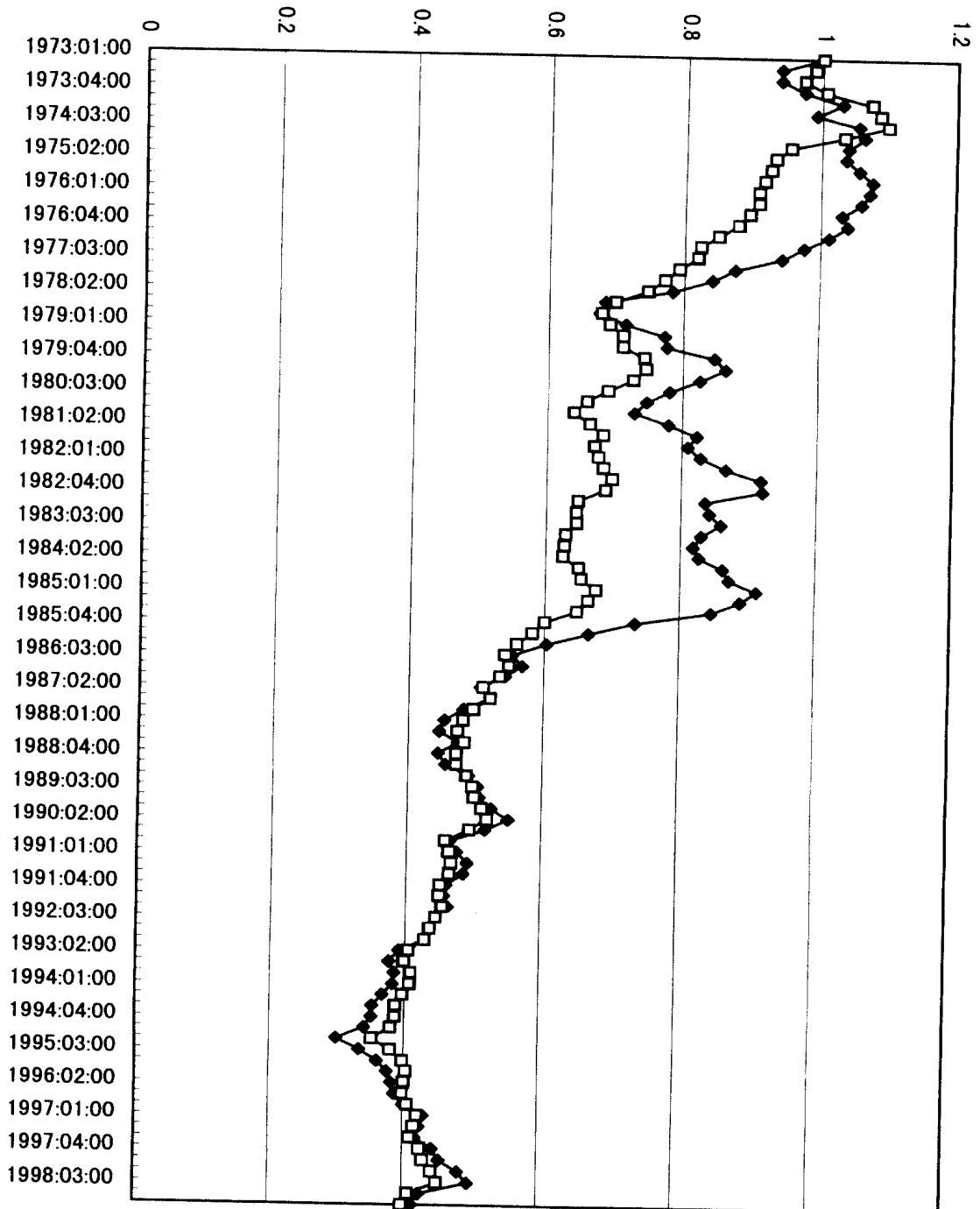
$$RO = 0.824$$

$$\begin{array}{rcll} \text{REXR} = & .9828 & +.027241 (\text{RUSINTL (2)} - \text{RJINTL (2)}) & -.09877 \text{ FASSETC (4)} \\ & (14.71) & (3.60) & (-1.65) \end{array}$$

$$\bar{R}^2 = 0.8402 \quad S = 0.039 \quad DW = 1.731$$



Graph 1



—◆— l3exr
-□- l3pexi.y/l3uspex@

exr: the spot yen-dollar
rate in Tokyo
pexi y: export price
index, yen, 90 = 100
US pex @: US, export
deflator, 92 = 100

to gravitate towards the the level of the PPP in accompanying over-shoot always both downward and upwards continuously since 1986⁽⁷⁾. However, we must pay a prudent attention to merely overshooting towards the equilibrium level of yen-dollar exchange-rates —the PPP of both countries— because excess overshootings would give sometimes very risky impacts on our economy and Asian countries⁽⁸⁾. The ship in the storm could not wait for the calm. We can arrive to such a conclusion as we economists, cannot sometimes forecast for the level of yen-dollar rates with fully perfect preciseness, therefore, we had better intervene the exchange market corporately⁽⁹⁾.

Note

- (1) Vandaele, W., (1983), *Applied Time Series and Box-Jenkins Model*, Academic Press, U. S. Introduction to the Time Series Analysis, translated into Japanese by Tihohiko Minotani and others, Taga Publishing;
- (2) H. Wago & K., Ban, "Economic Data Analyses by TSP," the second ed., Tokyo University Press, 1995.
- (3) The Oriental Economist Publishing, op. cit. Nikkei telecom. 21.
- (4) H. Wago & K. Ban, op. cit., PP., 184-199.
- (5) F. Bec et les autres, op. cit. D. J. Hodgson, op. cit.
- (6) M. Yoshitomi, *The Truth of the Japanese Economy*, Oriental Economist Publishing, December 1998.
- (7) The Oriental Economist Publishing, *Economate-W*, Macro data files, Quartary data files FD, 1999 summer.
- (8) K. Shiraishi & K. Baba, *Exchange-Rates and the Japanese Economy*, oriental Economist Publishing, 1996.
- (9) R. McKinnon & K. Ohno, *Dollar and Yen*, MIT Press, 1997, the Japanese Translation, Nihon Keizai Newspaper, 1998.